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This paper presents an exploratory case study of definitions, or assertions, of the Iron Age and its subdivisions consisting of name, date range, location, and source within two broadly defined geographic regions. The collected assertions represent a period label—the Iron Age—that would appear in an authoritative database of time periods that does not require a controlled vocabulary. Assertions were gathered from archaeological literature and related sources. Results showed that date ranges for the Iron Age varied both by region and scholar. Subdivisions within the Iron Age are also named differently depending on the geographic area. Consolidating definitions for an authority file would cause loss of information. This study is intended to address the role of authority files in temporal metadata in order to contribute generally to an understanding of appropriate metadata.

Headings:

Metadata

Authority files (Information retrieval)

A CASE STUDY OF ASSERTIONS FOR THE IRON AGE AND IMPLICATIONS FOR TEMPORAL METADATA CREATION

by
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Introduction

Addressing time periods in metadata records that are primed for interoperability on both an international and interdisciplinary scale remains an unfilled need (Rabinowitz, Shaw, & Kansa, 2012). The project leaders of PeriodO (*ibid.*) hope to create an aggregation of period definitions, or assertions, to serve this need without imposing a controlled vocabulary. Period assertions consist of a period name, an associated geographic region, an absolute date range with a beginning and end year, and a citation for the source of the period assertion, along with a Uniform Resource Identifier (URI). In this system, variants and conflicting definitions of a time period will be accepted as additions if they have an authoritative source, rather than lumped in to an existing assertion or rejected. The end goal of the project is to form an index of period assertions that can assist researchers and students in learning about interdisciplinary time periods (archaeological, geological, historical) and applying temporal metadata to their own work. The project would begin with assertions from the field of archaeology, but as it grows, it would add assertions from other fields.

This paper attempts to inform the process of developing such a system and more generally, the topic of appropriate metadata. It will include a literature review of understandings of authority control and ontology and discuss some attempts to address time in cataloging and metadata standards. I have made an attempt to integrate the design of PeriodO within these contexts in this review.

This paper will also include an exploratory case study compiling assertions of periods called “Iron Age” in two geographic regions: the U.K., Germany, and France (collectively UKE); and the Eastern Mediterranean (EM). These period assertions have markedly different dates between the two regions. What is not obvious to a layperson is how the period assertions vary *within* each region. After collecting period assertions from archaeological literature and other sources, a discussion of their implications for the design of a temporal-spatial metadata system follows. Questions addressed regard the variety and similarity of period assertions and their implications for building a database of period assertions, the characteristics of the sources cited for the definitions, and how these period assertions may be linked with other directories of time periods or Wikipedia.

Overall, I found period assertions varied between the two lists drastically. Other tendencies I observed were a diversity of period assertions for the Iron Age overall and for subdivisions at the most specific geographic level. Connecting between period assertions from PeriodO and other relevant information outlets remains a possibility, once the optimal level of granularity for access points is determined.

Finally, in order to provide a clear picture of the structure of period assertions, I include two models. One addresses a basic period assertion that follows the example appearing in the PeriodO project proposal. The other attempts to incorporate relational contexts such as super-periods, subdivisions, signifiers for the order of assertions and has part/is part notation according to suggestions by Doerr, Kritsotaki, & Stead (2010).

Literature Review

Authority, Controlled Vocabularies, and Ontologies

PeriodO aspires to serve as an authoritative index of time period definitions, and this prompts a discussion of how authority is defined in information organization. Robert Burger (1985, p. 3) lays out what is involved in authority work. By creating authority records and collecting them into an authority file, part of the work is complete. Next, the authority files need to be incorporated into bibliographic entries. Authority work continues by keeping the authority files up to date.

For Burger (1985), an authority record has five facets (p. 5). An authority record establishes an "… access point … that is used to permit the uniform application of this form for future additions to the catalog that also use that access point for retrieval" (*ibid.*) An authority record also allows it to be grouped with other records that have the same access point. Authority records allow bibliographic records to be standardized. They should explain how an access point was defined, and this should be done at the time the access point is defined. Finally, authority records may also denote non-standard versions of the access point. Michael Gorman (2004) finds Burger's description of an authority record enduring, but also adds that an authority file should "record precedents and other uses of the standardized access point for the guidance of cataloguers" (p.13).

Maxwell (2002) stresses the importance of authorities to facilitate use by the largest possible community of researchers and users. He writes, "… something more than local authority files is needed if libraries are to contribute to national and

international union databases ...” (p. 4). One could transfer this rationale from bibliographic records to resources on the Internet, such as research data sets. If researchers are to connect their findings on a topic to a wider network of related findings, an authority generally embraced by a discipline would assist.

Further explaining the importance of catalog records, Maxwell (p. 7) notes that they direct users to other—ideally all other—works based on a common attribute such as a subject. The importance of bringing sources into a more expansive catalog to connect more sources is clear, although Maxwell refers to an individual library’s collection instead of a more universal metadata scheme. Maxwell maintains that serving this function is not possible unless a controlled vocabulary is used, writing, “But the gathering function of the catalog does require that the gathering points be consistent and unique—that is, they must consist of a controlled vocabulary” (p. 7). But for chronological periods, PeriodO maintains that any one controlled vocabulary is not the best option, given the different definitions produced by a variety of schools of thought, geography, and dating methods. Can the “gathering” that Maxwell writes of be achieved by encouraging difference rather than enforcing control?

Connections based on chronological periods would benefit from an authority. However, the PeriodO project asserts that a traditionally conceived authority file that functions as a thesaurus of strictly defined period terms would not serve the best interests of researchers. The resource proposed by PeriodO’s project leaders would serve as an “authoritative hub” (p. 2) rather than an index of rigidly defined time periods. By an authoritative hub, this means that researchers and others seeking to add descriptive metadata denoting a chronological period could consult PeriodO for an existing assertion.

If none of the period assertions captures the geographical and time period the researcher had in mind, he or she could propose a new addition to the database. In proposing a new assertion researchers could use a controlled vocabulary they have chosen, or not. The authority of PeriodO lies in its centrality and use of reliable sources, as opposed to strictly enforced uniformity of terms.

Although PeriodO would not enforce a controlled vocabulary or attempt to build a strictly defined thesaurus, it would still function as an authority. Burger defines "authority work" as "…determining the form of access points and recording information about such decisions" (Burger, 1985, p. 1). PeriodO would certainly record access points for chronological periods as URIs and by including source citations, would serve as a record of the period assertion's reason for inclusion. This is at odds with Burger's definition for authority control that dictates "… headings in a catalog are consistent and [that] a mechanism (the authority file) and related cataloging policies have been established to ensure this policy" (*ibid.*, p. 1). By including the variously defined period assertions that exist, PeriodO would not be enforcing a controlled vocabulary and would allow contributors to use one of their own choosing. However, the period assertions would be required to include a name, date range, and geographic location. By insisting on this, PeriodO would be instilling authority control, albeit not in the same way Burger, Gorman or Maxwell intend.

Similarly, Gorman (2004) feels strongly that authorities do not function properly without enough control. Although a proponent for international collaboration of description, Gorman does not see them as possible without an international authority file of some kind (p. 19), and adding further stringency, "Vocabulary control is vital to

authority control" (p. 13). It is worth noting that Gorman calls for a "global authority file" (p. 20) for agents, titles, and subjects, but not explicitly time or geography.

Expanding from cataloging to metadata, Bruce and Hillmann (2004) create an outline of features that distinguish quality metadata. They write with particular regard to "… large-scale projects in which metadata from multiple source providers is aggregated into a unified metadata resource" (p. 243). The seven features they decide on are completeness, accuracy, provenance, conformance to expectations, logical consistency and coherence, timeliness, and accessibility. Bruce and Hillmann point to controlled vocabularies as an enhancement to metadata quality, but under conformance to expectations, they pose the question, "Are controlled vocabularies aligned with audience characteristics and understanding of the objects?" (p. 252).

PeriodO falls into the type of networked information collection that Bruce and Hillmann have in mind. They see controlled vocabularies as generally positive in this environment. But in the case of the users and contributors to PeriodO, a controlled vocabulary may be at odds with the users and the data they wish to contribute, thus violating the conformance to expectations. This study will explore the diversity of period assertions that exist for one period concept, the Iron Age. The results will inform the conversation on whether a controlled vocabulary for period assertions would hinder description.

Addressing Time Periods in Metadata and Authorities

The PeriodO project proposal responds in part to takeaways from a workshop held in 2004 to discuss curating and sharing archaeological data that calls for the establishment of an "information infrastructure" for archaeology (Kintigh, 2006). An

integral part of this infrastructure is clearly conceived metadata. Part of the justification for this is that there is a need "… to respond to concept-oriented (rather than data set-specific) queries" (p. 575). The report discusses two types of metadata that will be needed to support this infrastructure. The first is the more structural, syntactic metadata, and the second is semantic metadata. Semantic metadata includes, "temporal, spatial, and cultural contexts" (p. 573). The report favors using ontologies to organize metadata to facilitate search across data sets (p. 575). In the report's list of five features put forward for the infrastructure, one of them is, "data-integration tools that use syntactic and semantic digital metadata and ontologies to integrate disparate data sources, yielding a database of appropriately scaled observations with consistent variables" (p. 573). The report adds that scholars in topics local to a geographical area, such as a chronology or pottery style could draft their corresponding ontologies (p. 574). This provides some flexibility to allow for the diversity of period definitions. The report still specifies that though locally developed, these concepts would still be governed by ontologies.

The definition of ontology that Kintigh (2006) uses is broad. He defines it as, "a systematic representation of the relationships among concepts" (p. 573). A representation of relationships will certainly be helpful for compiling historical period definitions, but making this process "systematic" may be a problem. Ontologies and filing systems lend themselves well to arrangement of physical items, but it can be argued they are less vital with digital information (Shirky, 2005). This is because digital data can be hyperlinked to multiple other digital objects to map out its various relations. Linking related digital data could accomplish the same trans-dataset search goals that are sought for an archaeological data infrastructure. The need to insist on a standardized,

relational model for period definitions that the above understanding of ontology implies may not be needed. Furthermore, it may prove ineffective to attempt to "[design] categories to cover possible cases in advance…" (Shirky, 2005, part 1). Developers of ontologies for time periods should proceed with care.

An ontology can be thought to work when the body of items to be described is small, when distinctions between categories of description are clear, when the categories are formally defined, and if the items to be described do not change often, if ever (Shirky, 2005). These specifications are not germane to the period definitions I collected for the Iron Age, particularly for the Eastern Mediterranean locations. By the same logic, the types of creators that tend to facilitate adoption of ontologies are trained indexers or users with a thorough knowledge of the subject matter, along with an authoritative group to referee the classifications (Shirky, 2005).

PeriodO would have all of these human resources. The users would be subject area experts, and the addition of new assertions would be reviewed before they are added to the database. However, there does not appear to be an authority in archaeology that sets a standard for period definitions as there is for geology, as noted by Walsh, Gradstein, and Ogg (2004, cited by Rabinowitz *et al*., 2012). This is not a shortcoming of the field, but it diminishes the appeal of trying to apply an ontology or controlled vocabulary as part of the project.

A framework for encoding time in metadata records adds insight into the current state of time periods as metadata. A report outlining TIMEX2, a system of XML markup for encoding metadata for temporal expressions developed through the U.S. Defense Advance Research Projects Agency and the National Institute of Standards and

Technology's Automatic Content Extraction Program, focuses mainly on recording dates, duration, and frequency of events, then converting their format to an interoperable standard (Ferro, Gerber, Inderjeet, Sundheim, & Wilson, 2005). The report addresses what types of time and dates are appropriate to use with their system. Notably, TIMEX2 does not accommodate historical time periods. In their introduction to the report, Ferro and colleagues write that they are not aspiring to address all ways one could encode time information, and that this would be "… a hopelessly ambitious goal" (p. 1). Historical time periods fell outside the scope of TIMEX2.

TIMEX2 is adept at recognizing time references based on specified dates, but not for capturing historical time periods. TIMEX2 has established tokens in its code to accommodate BCE dates and thousand and million years ago annotations, but not for a historical period such as the Iron Age. Ferro and colleagues write for a value (VAL) in their markup tags, "… the general rule is that no VAL is to be specified if they are culturally or historically defined, because there would be a high degree of disagreement over the exact value of VAL" (p. 51). This statement is followed with examples such as "Golden Age" or "Cold War." A VAL, or value for the time designation, in TIMEX2 is not supposed to be open to interpretation, and therefore it steps away from the charge of describing the cultural and historical aspects of temporal metadata.

Library cataloging tends to address time periods as subject headings. In AACR2, Historical periods would fall most appropriately under the heading "Subjects (Events)" in the Subject Authority File, which includes empirical reigns, military events, and other historical instances (Maxwell, 2002, p. 85). None of these subject headings address a chronological period of geological or archaeological relevance. Designed to work in

conjunction with AACR2, Library of Congress Subject Headings (LCSH) attempt to include time and space as part of the subject field. Chronological and geographical are both subdivisions in LCSH, which are designed to "… [add] to subject terms as a means of limiting the scope of the term and of combining different concepts in a single subject string" (Maxwell, 2002, p. 227). Chronological subdivisions are covered under ‡y and geographical under ‡z.

MARC records adhere to AACR2 rules and also rely on LCSH. At one point, MARC records had a field to address history, 665, but since 1981 it has not been used (Burger, 1985 p. 108). This field is no longer part of the MARC standards, but MARC now has "Subject Added Entry" fields for both chronological terms, field 648, and also for geographical names, field 651 ("6XX: Subject Access Fields-General Information (Network Development and MARC Standards Office, Library of Congress)," 2008). Again, here the subdivision codes y and z can both be used in these fields for time and space, respectively. The changes that MARC standards have gone through with temporal notation may indicate the challenge of addressing it.

LCSH includes various listings for the Iron Age in its authority file ("Library of Congress Authorities," n.d.). There is an authorized heading (1XX) for the Iron Age and the European Iron Age (Iron age—Europe). There are also authorized headings specifically for the Iron Age in England, Great Britain, Wales, and Scotland as well as Germany. While they are not listed as authorized 1XX headings, there are subject headings in the directory for the Iron Age in countries that were also included in the sample for this study. For example, Israel, Palestine, Greece, France, Syria, and Turkey all have headings but not at the 1XX level. While there are entries for subject headings

that include the period name and a geographic region, the authority files for 1XX headings such as the Iron Age in Europe do not include date ranges.

The way historical periods are handled in LCSH does not get the same level of treatment as people do. If one were to look up an individual's name in LCSH, a date of birth would likely be listed in the heading. Other information such as place of birth may be included in the authority file. There is no such treatment for the Iron Age, and likely for other time periods, but this could be a possibility in the future.

The Getty Art and Architecture Thesaurus (AAT) ("Art & Architecture Thesaurus," n.d.) is another authority file that includes entries for the Iron Age. In AAT, the Iron Age is found in the "Styles and Periods Facet", nested under:

Styles and periods → styles and periods by general area → three age system → Iron Age

The next level after Iron Age has entries for the sub-periods Early, Middle, and Late. The Iron Age is described by AAT in broad-brush terms. It is more descriptive than LCSH in that it provides a couple of dates for the Iron Age, "It developed at different times in various parts of the world, first appearing in the Middle East and southeastern Europe around 1,200 BCE, and in China around 600 BCE" (*ibid.*, "Iron Age"). It provides start dates for three very different geographic areas, but no end dates. Neither are dates provided in the entries for Early, Middle, and Late Iron Age. These general descriptions would not prove helpful to many studying the Iron Age in a particular geographic context. In this same vein, the AAT includes a European Iron Age facet, which again, does not include any dates. There are no levels specific to the Iron Age in other geographic regions.

To the AAT's credit, it provides sources for the information in its authority file. The dates quoted above appear to be from *Encyclopedia Britannica* ("Iron Age (history)," 2013), a source cited in the authority file. The AAT provides well documented and organized information, but it does not provide a definition of a time period from its beginning to end within a particular region.

Doerr, Kritsotaki, and Stead (2010) outline a schema for classifying historical time periods that relies on the framework of the International Council on Museums' Committee for Documentation Conceptual Reference Model (CIDOC-CRM). They have developed their own list of four traits that a good thesaurus for time periods based on culture needs to have. The first is that instead of geography and time, the emphasis for defining the period should be "… based on the distinct characteristics of the archaeological contexts that are used by the respective scientific community to identify their unity" (p. 70). The other three traits are that the thesaurus entries be machine-readable, chronologically classify items with consistency, and help determine and label finds from the field (*ibid.*).

Within the model of the period definition, the authors envision a hierarchy for sub-periods. They also hope to include characteristics of the time period, such as notable artifacts or the politics of the time. For Doerr *et al.*, defining a period is not merely time, place, and source, it is contingent upon many other factors as well.

The authors have an elaborate idea of what constitutes context that includes much more than a source for the period definition. This leads to an entry for a period that is verges on an encyclopedia entry. In developing quality metadata, it can be tempting to

think too big. Bruce and Hillmann (2004) advise that quality metadata should not be unrealistic in its aims by making elements that will not plausibly be used.

By keeping their assertions composed of name, dates, place, and citation, PeriodO would present a choice for temporal metadata that would be straightforward to implement. A similarity between the two is that like PeriodO, within their proposed model, Doerr *et al.* place emphasis on the source of the time period. In Doerr *et al.*'s method, the first published instance of a time period definition is the designated source for each of the period terms.

Responding to a need for more attention to time periods in metadata records, researchers at UC Berkeley (Petras, Larson, & Buckland, 2006) considered library catalog records. They reported that bibliographic entries tend to include time description as dates, but that people tend to refer to time by period names. The authors propose a system for recording time periods, which they initially sourced from LCSH authority files. They gathered LCSH authorities and crosswalked information from target fields to a form they created for their Time Period Directory. Data from the $y field was moved to a time period field in the Time Period Directory and data from the $z field to a one for geography. This created a list of time period definitions that linked dates and geography. In order to more specifically define the geographic entries, the authors added links to a geographic gazetteer in the Time Period Directory.

Petras and colleagues admit that their pilot data set, LCSH, is uniform, and that more work would need to be done with more diverse definitions (pp. 159-160). The authors suggest other possible sources to tap, writing,

> "For general historical events, any encyclopedia or domain chronology would lend itself to being harvested. Other classification systems and thesauri can be

> mined as well. For artistic periods, for example, the Getty Arts and Architecture Thesaurus provides a 'Styles and Periods Facet', which seems very suitable for incorporation into a more structured and searchable schema as the Time Period Directory Content Standard provides." (p. 160)

Sources outside of authority lists and thesauri would also provide a different level of insight into endeavors to create a metadata scheme for time periods.

Petras and colleagues mention the Getty AAT as a next source to try. If the example of the Iron Age entries is any indication, both start and end dates are not likely, nor are specific geographic areas. The AAT would not be the best choice to mine data to build period definitions based on dates and specific locations.

A survey of period definitions from various scholars in the field of ancient history would be another possible supplier instead of other authority files. Locating appropriate scholarly sources and finding dates and locations within them involves more legwork than consulting an authority file. However, the AAT entry for the Iron Age shows that by providing the most general description, the period definition is flattened. A review of literature from a discipline concerned with time, such as archaeology, would better serve the cause. I attempt to display some of the variety of period assertions that can exist for one period label with the sample gathered in Appendices A and B.

Kintigh's (2006) report depicts a successful infrastructure that accommodates data from various creators and uses metadata that designates temporal and geographic information. Dublin Core is a basic, flexible metadata scheme that can be used to describe information resources in any discipline, including archaeology. Consulting the Dublin Core Metadata Initiative's guidelines for its element schemes ("Dublin Core Qualifiers," 2000) gives insight into the current state of temporal and geographic metadata. If one were entering metadata according to Dublin Core's element set,

information about time periods or geographical area would be entered under the "Coverage" element. The coverage element has the option of adding spatial or temporal qualifiers to the element. Dublin Core recommends using the Getty Thesaurus of Geographic Names (TGN) to standardize entries for spatial coverage. However, there is no recommended authority for temporal coverage in Dublin Core.

While Dublin Core's treatment of time suggests room for an authority for time periods, the case of the geologic field gives pause for standardizing periods. Geology works within the bounds of the Global Stratotype Section and Point (GSSP) system. This system aims to put a definite start and end date for each geologic time period, authoritatively standardizing periods for the entire international field and creating "classificatory pigeonholes" (Walsh, Gradstein, & Ogg, 2004). This type of approach to standardizing time may seem flattening to those outside of geology.

The discussion above demonstrates that there is a desire for metadata designated for time periods, as evident by Petras *et al.* (2006), Kintigh (2006), and Doerr *et al* (2010). After examining the aspect of time in cataloging rules, metadata schemas, authority files, and pilot authorities (Petras *et al.*; Doerr *et al.*) it is evident there is room for more work on handling time in metadata. What follows is a report on an attempt to gather authoritative period assertions for the Iron Age in order to contribute to an understanding of how to approach metadata for a field that depends on time, archaeology. This could in turn be of use in the design of an "authoritative hub" like PeriodO.

Methodology:

Sample for Case Analysis

This report describes a case study of one time period label that could appear in an authority file of time periods within the context of two geographic regions. The sample time period label, the Iron Age, was selected because it is used to label time periods that have different start and end years depending on location or scholar. The sample is not comprehensive for either geographic area, but provides a sense of the period assertions that can be derived from the literature available on the topic of the Iron Age.

I conducted searches of sources to form two lists of period assertions for the Iron Age in the Eastern Mediterranean (EM) and the Iron Age in Western Europe, specifically the U.K., Germany, and France (UKE). I selected some of the sources on both lists by referral from one of the project leaders for PeriodO, who also supplied a data file with period assertions from the GeoDia database, an online resource about the ancient Eastern Mediterranean ("GeoDia," 2011). I identified other sources by searching the library catalogs at University of North Carolina (UNC) and Duke University and searching journal article databases through the UNC library. I identified at least one source (Mazar, 2005) and obtained it through Google Scholar.

The process for identifying sources for the Iron Age in Europe also involved Google searches and browsing stacks at the library along with searching for key words such as the "Iron Age" in library catalogs and article databases. After I refined searching to include "chronology" and sometimes a geographic area, searches became more

targeted, and sources appropriate to the geographical regions in both the EM and UKE lists were more easily identifiable. I used this streamlined, targeted searching more in forming the EM list than the UKE list.

I also gathered information from these sources on related periods. Related periods are defined as sub-divisions within the Iron Age, differently named time periods in Europe or the Eastern Mediterranean that were concurrent or overlapped with the Iron Age, and periods immediately before or after the Iron Age.

Ultimately, I collected period assertions from 17 different sources on the EM list. Period assertions for the Iron Age in the UKE list were collected from 9 sources. Sources included period definitions harvested from the GeoDia Database, timelines developed for museums and cultural heritage, and scholarly publications from the field of ancient archaeology. Scholarly publications here are books and journal articles.

For the UKE list, the sources of period assertions were the GeoDia database, 3 books, one journal article, 2 museum timelines, a timeline provided by the Archaeological Records of Europe-Networked Access organization ("ARENA Search Portal," 2004), and a controlled vocabulary known as the Portable Antiquities Scheme ("Details for the Iron Age period," 2003). For the EM list, the period assertions were collected from the GeoDia Database, 4 journal articles, 12 books or sections from books, and 1 from a timeline from an art museum.

Data Collection and Research Questions

I kept a log to track sources consulted for a period definition or other entry for the Iron Age (museum guide, book, thesaurus, etc.). An example of an "other entry" would be a source that discusses the Iron Age and lists related terms, but for which I could not

find a beginning and end date for periods. Not all sources logged were added to the two final lists that formed the sample for discussion. Only sources from which a date range for a period assertion was derived were added to the two lists. The log included:

- Whether the source provided a date range for the Iron Age and if so, the date range was recorded
- Whether the consulted source cited any sources for its stated date range, and if so, noted information on these sources
- Notes about time periods before and after the Iron Age and general notes about time periods that were concurrent with the Iron Age in the specified geographic area

As the sample of period assertions for the Iron Age was collected, I recorded further observations to address the following questions:

- Was a source citation provided for the period definition? If so, is there an apparent justification for the source's selection?
- Across the various sources of Iron Age definitions, how much consensus is there between sources? Did any of the definitions cite the same source or date range?
- When sources for period assertions that share the same name and geographic region differ in date range, how different are the sources and date ranges?
- Are different sources similar enough to be fused or consolidated?
- Once period assertions are identified, how convenient would it be to map between other period definitions, such as those defined by Wikipedia, the Library of Congress Subject Headings (LCSH), or the Getty Art and Architecture Thesaurus (AAT)?

Formal Models of Period Assertions

I include to models to provide an understanding of the relational contexts for period assertions. The first model (Figure 1) follows one proposed by Rabinowitz, Shaw, and Kansa (2012) in the project description for PeriodO. The diagram is centered on one period assertion (Iron Age) and its corresponding date range. The assertion is mapped to the related source citation and the applicable geographic location.

The second model (Figure 2) is partly based on a time period model proposed by Doerr *et al.* (2010) in that it includes relational diagramming to sub-periods within the Iron Age and lists the Iron Age as a super-period, declares the part of/has part relationship, and signifies the order of sub-periods. PeriodO has considered including a framework for additional relations, and this model provides one illustration of how a period assertion with multiple subdivisions may be diagrammed to relate the subdivisions to each other and to a parent term, the Iron Age. These considerations may be useful in the development of access points once a database of period assertions is established.

Findings and Discussion

Sources Citing Sources

One of the research questions was whether or not the sources consulted for time period assertions cited sources for their definitions. In the case of the museum timelines and the ARENA search portal, they did not cite additional sources for their date ranges. The Portable Antiquities Scheme includes a list of citations for its entire scheme that includes more than 2500 entries, but did not link a particular source to the Iron Age period definition. For the GeoDia Database entries listed in Appendices A and B, all period assertions cited at least one, no more than two sources. As the output was a .json file of the raw data, the justification for using a source was not apparent. Overall, I failed to collect observations that reflect justification. Determining the preference for a source could be an area for future study.

The journals and books consulted all had extensive bibliographies, but it was difficult for a layperson to connect specific sources to specific dates. A citation of a destruction event may have been the definition of the beginning or end of a subdivision in the Iron Age according to a scholar, but someone outside the field of archaeology would not be able to make this connection unless it was explicitly stated. If an evident citation for a date range was observed, it is recorded in Appendices A and B.

Some sources created separate bibliographies for their chronology sections (Collis, 1984; Dever, 2003; Dickinson, 2006) or listed a bibliography accompanying their table (Hill, 1995). Notably, Dickinson (2006) devotes a section of the bibliography to

chronology that includes 16 sources. In the same work by Dickinson, in the section of the main text that addresses the chronology of ancient Greece, he accompanies the text with additional citations. These instances of dedicated chronological bibliography were not as common as may have been hoped. Furthermore, many sources review other sources of chronological information at length (Dickinson, 2006; Grabbe, 2007; Whitley, 2001; Younker, 2003, others), and as a result, definitively matching specific date ranges to a specific source proved to be too challenging.

There were some clear links between dates and the other scholars the authors reference as sources for those dates. Of note, Wallace (2010) recorded sources for beginning and end dates for the Early Iron Age in Crete. However, it would seem there are multiple sources listed for both the beginning and end dates. Grabbe noted a date range for the subdivision Iron IIA in Israel that he attributes to Mazar (2005), though he does not formally accommodate Mazar into the chronology he provides. For the most part, though, a clear source for the beginning and end of each subdivision, or for the entire Iron Age was not explicit among the sources consulted.

I focused on citations of other scholarly works in chronologies from the consulted resources. One of the resources included some thought on sources, writing,

> "… source includes not just literature or inscriptions but archaeology, surveys, demographic studies, and so on. Any ancient history should depend as far as possible on 'primary sources,' the principle already laid down by von Ranke (§ 1.3.1)." (Whitley, 2001)

In hindsight, it would have been useful to record additional information on how the date range was derived. Doerr and colleagues (2010) propose to incorporate information about artifact style, power structures, and excavation stratum with a period definition, with the justification that it would explain discrepancies between definitions (p. 72-73).

The project leaders for PeriodO have acknowledged that depending on the data source for the stated date range, such as dendrochronology or radiocarbon dating, conflicting ranges may arise (p. 3). Adding the method used to date artifacts or ancient literature are other options to consider. For example, in a paper about dating the Iron Age in the Levant (Finkelstein & Piasetzky, 2010), the authors state that their chronology was based entirely on radiocarbon dating, and not by consulting ancient literature or another source. Including dating methods in the period assertion could indeed explain discord. It may not be feasible to include information about the method of dating in the entry for a period assertion, though. In an instance of a date range that is defined from a composite of methods, this would be taxing to concisely communicate. Including dating method in the period assertion would provide more contextual understanding of the date range, but based on the difficulty aligning bibliographic sources with date ranges in this sample, it would not be practical in many instances.

An additional research question was whether any of the sources cited each other. From the Eastern Mediterranean definition list, sources that discuss the chronology of the Anatolian Iron Age, in what is now Turkey, tend to refer to some version of Mary Voigt's work at Gordion (DeVries, Darbyshire, Rose, and Voigt, 2011; "GeoDia," 2013; Summers, 2008). Authors focusing on Greece (Dickinson, 2006; Whitley, 2001) mention Anthony Snodgrass (2001/1971). While Wallace (2010) does not ascribe to using Snodgrass's description of Dark Ages, she does mention his work in her writing. These were some of the most prominent instances of sources finding a popular scholar to cite. However, as stated above, the source of time periods was not generally clear, and this

confounds a more extensive analysis of whether sources are citing each other for specific date ranges.

A similar problem with sources citing each other arose with an article on the Levant. In a reply (Bruins, Nijboer, & Van der Plicht, 2011) critical of what is known as the "Low Chronology" of the Iron Age, the authors list two chronological tables for the site at Tel Dan. One is a chronology the authors reject, which they attribute to work by Israel Finkelstein. The other is the chronology they accept by Avraham Biran. If one were building a database of period definitions and their sources, this chronology was retrieved from a paper by van Bruins and colleagues, but it is not a chronology they support. As previously noted, a similar situation occurs with Grabbe's citation of Mazar. This confusion is something to consider in the implementation of a time period registry.

Consensus

The AAT provides a start date for the Iron Age as 1200 BC for the Middle East and Southeastern Europe. The countries in these regions are not further defined. If one were to compare this start date for the Iron Age to the dates in the lists compiled here for both Europe and the Eastern Mediterranean, it becomes apparent that such a broad definition of the time period is troubling. For one, the AAT description definitely does not include the United Kingdom, and presumably Germany and France are not part of Southeastern Europe. According to the UKE list, the Iron Age in the U.K. did not begin until 800 BC at the earliest. In fairness, several sources cite a subdivision of the overlapping period Hallstatt A or A1 at 1200 BC (Collis, 1984; Snyder, 2003), but also as early as 1300 BC (Cunliffe, 2005).

Surprisingly for the EM list, most of the sources do pin the first part of the Iron Age to around 1200 BC or sometime in the 12th c. BC. According to Finkelstein's low chronology for Tel Dan (as cited by Bruins *et al*., 2011), the first part of the Iron Age does not begin until 1000, though. In another low chronology of the Levant, the start of the Iron Age, Early Iron I, begins in 1109 (Finkelstein & Piasetzky, 2010). Greece differs slightly by beginning the Early Iron Age around 1050 BC (Dickinson, 2006) or 1000 BC (Whitley, 2001). For the Anatolian Iron Age, one definition begins the period earlier at 1250 BC in the eastern part of the region (Çevik, 2008). The 1200 BC start date for the Iron Age writ large is more in line with the dates in the EM list than those in the UKE list for the United Kingdom. However, by providing dates at all for the beginning of the Iron Age broadly defined, the AAT has opened up a can of worms.

A feature that was prevalent in the sample was very specific geographic locality. The project leaders for PeriodO note that chronologies specific to one archaeological field site were a possibility, and that the database of period assertions could accommodate this level of locality (p. 5-6). In gathering the period assertions in the sample, this became evident. The chronologies sourced to Biran and Finkelstein (Bruins *et al.*, 2011) were specific to the site at Tel Dan, Israel. The chronology by Voigt that was cited by Summers, DeVries and colleagues, and GeoDia is specific to the site at Gordion.

Based on their writing, scholars tend to be hesitant to apply the chronology they have developed at a site or have cited to a wider geographic area. DeVries and colleagues write of the Iron Age chronology at Gordion, "Their implications for the Anatolian Iron Age in general are considerable, though it will be the task of others to evaluate them" (p. 1). In her book on the history of the island of Crete, Saro Wallace

(2010) writes, "Analysis even at the island level is sometimes too general to be meaningful, and we need to move down to the level of the small region…" (p. 9). She later adds, "In sum, I treat the island in this period as a valid, but never restrictive, analytical unit" (p. 9). Although Snodgrass (2001/1971) is not included as one of the entries in the sample, he writes in an introduction to the 2001 edition of his book what he might have changed if he were to re-write his 1971 work. He offers, "There would have been even more stress of regional differences" (p. xxxii). With regard to trying to define the Iron Age limited to Turkey and surrounding areas, Summers (2008) admits, "… this laudably simple idea turns out to have complex solutions, with little likelihood of achieving much, if any, consensus" (p. 203).

This tendency was present in the sources consulted for period assertions in the United Kingdom as well. A source that did not yield a period assertion for the sample included in Appendix B (Harding, 2004) examined the Iron Age from the northern part of Britain. Since Roman rule did not extend into the north of the present U.K., the Iron Age was longer here, and a definition that ends the Iron Age at AD 43 would not be accurate. The author prefaces this information with a caution against generalizing even within the region. He writes, "… chronological thresholds that might be applicable to one region of Northern Britain will not necessarily or automatically be apposite for the other regions, compounding the problems of devising a workable system of classification and terminology" (p. 3). Another source (Snyder, 2003) points to Cunliffe as a proponent for dividing the United Kingdom and Ireland into Channel and Atlantic zones for Iron Age chronology. Snyder also writes that there is a tendency to focus on specific Iron Age cultures in the United Kingdom (p. 16). The sample I collected did not reflect this, but

that could be due to the limitations of time and my level of familiarity with sources on the subject. The desire for hyper-local chronology is present in sources for both Europe and the Eastern Mediterranean. In compiling a database of period assertions, developers should be prepared for a high level of regional precision.

Consolidating Period Assertions

Another one of the research questions was whether period assertions were comparable enough to be fused or consolidated. If one were to try to define a period range for the entire Eastern Mediterranean, based on the definitions in the sample, it would be difficult. For sources that provided definitions that spanned the entirety of the Iron Age, as opposed to one or several subdivisions only, the following comparisons can be made:

Table 1 Selection of Date Ranges Encompassing Entire Iron Age for Eastern Mediterranean

Source	**Date Range**	**Geographic Region**
Heilbrunn Timeline of Art History (2000)	1200-586 BC	Eastern Mediterranean and Syria
Wallace, S. (2010)	1200-480 BC (Iron Age and Archaic)	Crete
Summers, G.D. (2008)	Early 12th c.-333 BC	Central Anatolia
Summers, G.D. (2008)	12th c. -330 BC	Gordion, Central Anatolia
DeVries *et al.* (2011)	1100-333 BC	Gordion, Central Anatolia
Summers, G.D. (2008)	Early 12th c.-547 BC	Northeastern Central Anatolia
Aharoni (1982)	1200-586 BC	Israel
Finkelstein and Piasetzky (2010)	1109-Early 6th c. BC	Israel
Mazar (2005)	1200-520 BC	Southern Levant (Israel)
Younker, R.W. (2003)	1200-mid 6th c. BC	Palestine
Dever, W.G.	1200-539 BC	Palestine
GeoDia Database	1000-586 BC	The Levant
Hodos, T. (2006)	1200/1100-600 BC	Northern Syria

From Table 1, it is evident that trying to consolidate all these assertions into one compromised date range for the Iron Age in the Eastern Mediterranean would be problematic. Remarkably, 1200 or the 12th c. BC seems to be a pretty common start date for the Iron Age across the different geographic regions, except for the definition for Israel provided by Finkelstein and Piasetzky (2010) and DeVries *et al.* (2010) for Gordion. Things go awry from this point, though. Admittedly, there is some consensus on an end date of 586 BC from definitions provided by the GeoDia Database (2013), Aharoni (1982), and the Heilbrunn Timeline of Art. Summers (2008) and DeVries and colleagues also agree on an end date for the period at Gordion. Within Central Anatolia, though, Summers cites two very different end dates for the Iron Age, approximately 330 BC in Central Anatolia, and 547 BC in Northeastern Central Anatolia. The diversity of date ranges that define the Iron Age in the Eastern Mediterranean is evident. Furthermore, the diversity in date ranges that can be present within a smaller area such as Central Anatolia further emphasizes the need for temporal metadata that can accommodate various definitions based on regional geography, such as Summers lists, or different interpretation, such as Finkelstein's and his partners'.

If one looks at subdivisions for the Iron Age in Israel/Palestine alone, there are a variety of date ranges. The abundance of date ranges for Iron Age subdivisions has been called, "only partially controlled chaos" (Grabbe, 2007, p. 11). To provide an idea, consider two subdivisions, IA and IIA. Some of the end dates for Iron IA in Israel are 1150 BC (Aharoni, 1982; Grabbe, 2007; Younker, 2003), 1047 BC (Finkelstein & Piasetzky, 2010), and approximately 1140-1130 BC (Mazar, 2005). There is a pretty high degree of consensus with 3 of 4 ending the subdivision at 1150 BC, and another

source within 20 years. For Iron IIA, Aharoni and Younker are still in accord, ending the subdivision at 925 BC. Grabbe provides two choices for ending, one at 900 BC and one at 830 BC that he attributes to Mazar (2005). Mazar ends period IIA at either 840 or 830 BC. Finkelstein and Piasetzky have two subdivisions of Iron IIA, early and late, which span 920-883 BC and 886-760 BC, respectively.

Some time periods other than the Iron Age may be easily standardized. However, examples from the Iron Age in Israel demonstrate that there can be variety in period assertions that share the same name in the same region. These can discourage consolidation, particularly at the subdivision level. A metadata system that addresses periodization will ideally accommodate different definitions for the same subdivision, such as the framework put forth for PeriodO.

The case of the period assertions in Central Anatolia that source their dates to Mary Voigt's work provoke discussion on whether to consolidate similar assertions into one:

Table 2 Period Assertions for the Iron Age in Central Anatolia/Gordion Attributed to Mary Voigt

Date Range	**Source**
GeoDia Database	1180-950 BC
Summers, G. D. (2008)	ca. 12th-ca. 950 BC
DeVries, K., Darbyshire, G., Rose, C. B., and Voigt, M. (2011)	ca. 1100 BC-900 BC

The three assertions are all for the Early Iron Age in Gordion, or in the case of GeoDia, Central Anatolia. All are sourced to Voigt as author or co-author, admittedly at different dates. The date ranges listed in Summers and GeoDia are pretty close, and could potentially be combined. The third by DeVries and colleagues differs by 50 years,

though. Deciding whether to combine these in some way will be a decision that PeriodO will need to make as they build their database of period assertions.

To add further support for the argument for inviting diversity, a similar survey of the period definitions that apply to the Iron Age in the United Kingdom and regions that include the United Kingdom provides similar information:

Table 3 Date ranges for the Iron Age that include England

Source	**Date Range**
British Museum	800 BC-43 AD
ARENA (2004)	800 BC-43 AD
Snyder, C.A. (2003)	800-100 BC
Cunliffe, B. (2005)	800 BC-50/75 AD
Hill, J.D. (1995)	700 BC-50AD
Collis, J. (1984)	650 BC-0 AD
Heilbrunn Timeline (2000)	750-50 BC
Portable Antiquities Scheme	800 BC-42 AD
GeoDia Database	800-43 AD

Using the example of one country, England, one can see a variety of both start and end dates for the Iron Age. Granted, some of the sources (Metropolitan Museum of Art, 2000; Snyder, 2003) include England in a larger grouping of Europe. By doing this, though, they end the Iron Age earlier than the others, which more accurately depict the period's duration until the Romans began their rule in England. Examining period definitions for the Iron Age in England also indicates that fusing definitions of the Iron Age leads to a loss of information.

Another complication in trying to consolidate periods, especially within the EM region, is that the same labels are not given to subdivisions of the Iron Age throughout the region. In Israel and Palestine, labels for subdivisions tended to follow the convention IA, IB, IIA, IIB, IIC, III. In Crete, the terminology is "Early Iron Age", followed by the Archaic Period (Wallace, 2010). In Gordion, a region of Central

Anatolia, the terminology for scholars using Mary Voigt's chronology (DeVries *et al.*, 2011; Summers, 2008) is Early Iron Age, followed by Early, Middle, and Late Phrygian periods. "Phrygian" is a label that is derived from a kingdom name in the region. The chronology listed for Northern Syria (Hodos, 2006) divides the period into I and II. Given that the names and number of period divisions for the Iron Age are different by region, it follows that the corresponding date ranges are also different. Consolidating the subdivisions into one period would lose subtleties of the chronology.

In the UKE list, there was a tendency to use three different labels. Sources referred to the Iron Age and subdivisions along with assertions for sub-periods of Hallstatt and La Tène, whose dates overlapped in some places with subdivisions of the Iron Age. Hallstatt and La Tène describe artifact styles and are named after sites in Austria and Switzerland (Snyder, 2005). Collis (1984), Cunliffe (2005), Hill (1995), and Snyder included all three in their chronology tables. The way Hill divides subdivisions in the Iron Age scheme and the Hallstatt/La Tène scheme tend to align beginning with Hallstatt C and diverging at La Tène D, but the other authors do not neatly pair subdivisions of the Iron Age with the Hallstatt and La Tène sequences.

The Middle Iron Age has been used to describe the United Kingdom variously between 450-100 AD (with differing start and end dates depending on the source). In Germany and France, the same time range is covered with shorter La Tène subdivisions. Not surprisingly, the date ranges for the subdivisions of La Tène also vary by source. Collis (1984) divides La Tène into subdivisions A-D, as does Hill (1995), who bases his timeline on Collis. However, Collis uses two La Tène systems, one in parts I-III for France between around 525-50 BC, and the aforementioned A-D for Southern Germany

between 475-circa 25 BC. Hill assigns the A-D subdivisions to "Continental Europe," which would presumably include both France and Germany. This sacrifices the subtle differences between the two regional chronologies.

Integrating Assertions with Other Authorities

Given the diversity that characterizes the period assertions in the UKE and EM samples, it might seem difficult to map to other authority files such as the LCSH or AAT. As explained above, both LCSH and AAT are not very detailed in their records for the Iron Age. Trying to take in their headings for time periods as entries in the PeriodO database would not be fruitful. Similarly, it may seem difficult to map to Wikipedia. This will depend on the design for access points that PeriodO chooses, though.

Linking to the LCSH may be somewhat frustrating to try. As noted before, many of the geographic areas in the sample have Iron Age listings in the LCSH list. Not all of them are authorized 1XX headings with their own hyperlinked authority file, though. It may only be possible to add PeriodO URIs to more popular subject headings. This somewhat defeats the spirit of the project.

Additionally, the authority record for the Iron Age in LCSH is Spartan ("Iron Age, Library of Congress LCCN Permalink sh85068153," n.d.). It includes the control number, the LC Classification, a topical heading, and a "see also" field that includes only the broader term "Civilization." If this indicates LCSH authority records for other time periods, then there would likely be a better outlet to add PeriodO hyperlinks for the purposes of interconnecting more data.

In the case of the AAT, adding links for period assertions would add depth to the "Styles and Periods" facet. If the Iron Age lists contained in the appendices are any

indicator, the level of subdivision that the AAT accommodates will not do justice to the granularity of period assertions that exists in the archaeological community. If a more general link that serves as an access point to a more diverse depiction of a time period in PeriodO were incorporated, this may reconcile the disconnect. One option could be to link from the AAT entry for the Iron Age (or Early, Middle, or Late Iron Age) that leads to a portal of geographic areas and their further subdivisions. By a portal, this does not mean a hierarchy necessarily, but a uniting term from which similar assertions could be compiled for access.

Adding identifiers to Wikipedia is fairly simple, and once a referee such as PeriodO has established a format for assigning Uniform Resource Identifiers (URI) for assertions, any Wikipedia editor could incorporate the URI within a citation on a Wikipedia page by using the *url=* command in the <ref> tags that form the citations. Other options could include adding the URI to the External Links section of the page, or submitting a request to add PeriodO identifiers to Wikipedia's Authority Control Template ("Authority control," 2013).

The Virtual International Authority File (VIAF), an authority for disambiguating persons, developed a bot to skim Wikipedia and add a VIAF identifier to articles (Klein, 2012). With enough unique identifiers for period assertions, automating their addition to Wikipedia pages could have potential. Again, dealing with plurality of period assertions may prove challenging in designing a functional access point more general than a URI to streamline any of these efforts.

LCSH, AAT, and Wikipedia could all benefit from an added dimension of geographically based temporal information. Wikipedia would be the easiest place to

start, because of its flexibility and open community. AAT is more thorough in its treatment of the Iron Age than LCSH, and it may be the next best choice for pursuing linked data. LCSH is widely recognized in the United States, but its treatment of time periods is more basic than the information that PeriodO aims to provide.

Models of Period Assertions

In order to illustrate how the assertions collected may fit into PeriodO's organization, two models follow. The first is a relational diagram that illustrates one period assertion with an instance of its use. The second model draws from the organization proposed by Doerr *et al.* (2010) that highlights relations between super-periods and sub-periods and signifies order. The model they propose includes more complex criteria such as defining attributes, starting events, and ending events that this model does not attempt to include. PeriodO is considering the use of broader period terms with subdivisions underneath, and this diagram provides one instance of how that might be made. The period assertions that are the subjects in the models are Hallstatt C from Collis (1984) and the Iron Age in Israel and its subdivisions, from Mazar (2005).

Figure 1 Relational diagram of one period assertion for Hallstatt C and an instance of use

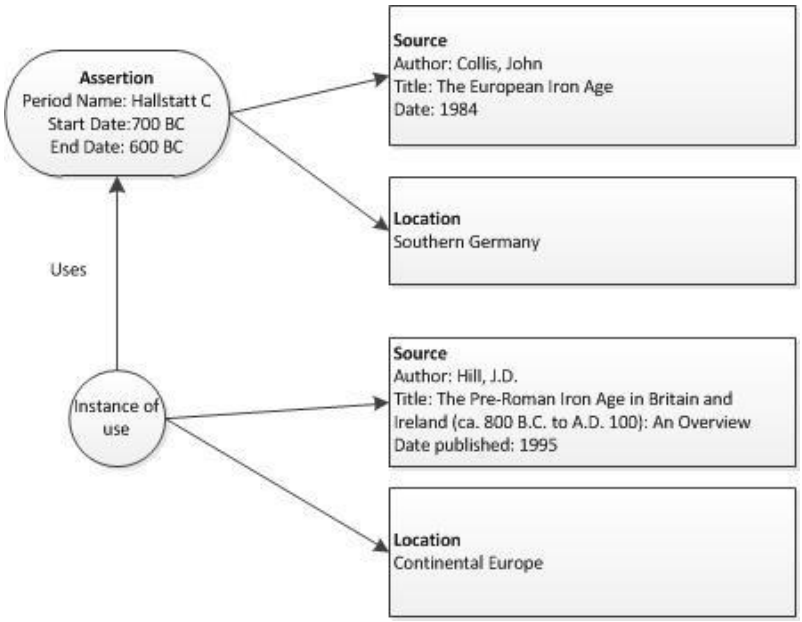
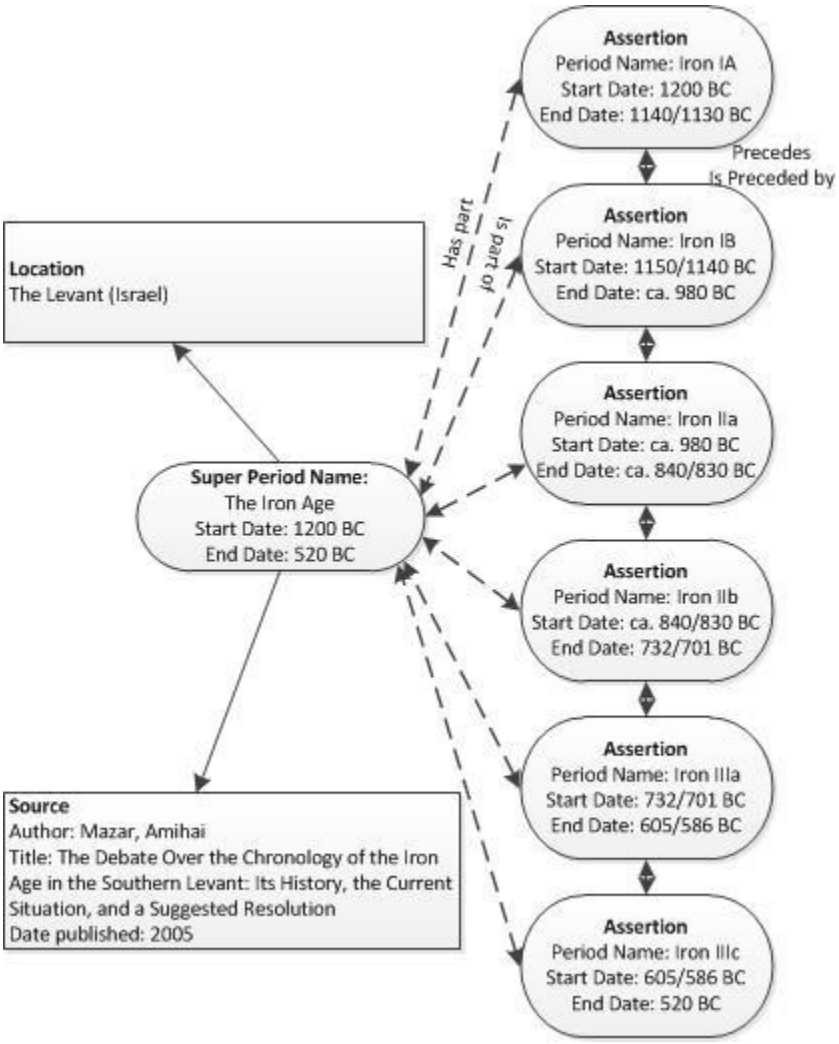


Figure 2 Relational diagram of subdivisions of the Iron Age in the Southern Levant



Conclusion

PeriodO seeks to fill a role for geo-temporal metadata by inviting variety and not requiring controlled vocabularies. This diverges from understandings of authority control from cataloging literature. However, by using a consistent format of name, date range, location, and source, a standardized system will be in place. After examining a sample of different ways multiple sources have defined the Iron Age and its subdivisions according to location, it becomes apparent that imposing one controlled vocabulary would sacrifice information. Given the trend of archaeologists' emphasis on a more regional level, this loss would not be appreciated. The plan of attack PeriodO has decided on is in the best interests of its stakeholders. What is needed next is a framework for establishing access points and determining how to best make a resource like this operational.

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Appendix A: Period Assertions for the Iron Age in the Eastern Mediterranean (EM)

Source	Period Name	Date Range	Country/Geographic Region	Citation
Heilbrunn Timeline of Art History	Iron Age I	ca. 1200-1000 BC	Eastern Mediterranean and Syria	
Heilbrunn Timeline of Art History	Iron Age II	ca. 1000-586 BC	Eastern Mediterranean and Syria	
Dickinson, O. T. P. K. (2006)	Early Iron Age	1050 or 1025-700 BC	The Aegean (Greece)	Various sources cited
Whitley, J. (2001)	Dark Ages or Early Iron Age	1000-700 BC	Greece	Snodgrass (1971); Morris (1999)
Wallace, S. (2010)	Early Iron Age	ca. 1200-700 BC	Crete	For Beginning: Haggis (1993); Hallager and Hallager (2000); Kanta (1997); Nowicki (2000); Tsipopoulou (1997). For End: possibly de Polignac (1995); Hagg (1983); Morris (1987)
Wallace, S. (2010)	Archaic	ca. 700-480 BC	Crete	
GeoDia Database	Early Iron Age	1180-950 BC	Anatolia	Voigt, in Kealhofer (ed.), (2005)
Summers, G. D. (2008)	Early Iron Age	Early 12-11th c. BC	Central Anatolia (Turkey)	
Summers, G. D. (2008)	Middle Iron Age	10th-7th c. BC	Central Anatolia (Turkey)	
Summers, G. D. (2008)	Neo-Assyrian	708 BC	Central Anatolia	

Source	Period Name	Date Range	Country/Geographic Region	Citation
			(Turkey)	
Summers, G. D. (2008)	destruction?	mid 7th c. BC	Central Anatolia (Turkey)	
Summers, G. D. (2008)	Middle Iron, possibly Archaic	ca. 600-550 BC	Central Anatolia (Turkey)	
Summers, G. D. (2008)	Middle Iron, possibly Archaic	ca. 590-550 BC	Central Anatolia (Turkey)	
Summers, G. D. (2008)	Late Iron/Achaemenid/Persian	547-333 BC	Central Anatolia (Turkey)	
Summers, G. D. (2008)	Early Iron Age	ca. 12th-ca. 950 BC	Central Anatolia, Gordion (Turkey)	Voigt and Henrickson (2005)
Summers, G. D. (2008)	Initial Early Phrygian	ca. 950-900 BC	Central Anatolia, Gordion (Turkey)	Voigt and Henrickson (2005)
Summers, G. D. (2008)	Early Phrygian	ca. 900-800 BC	Central Anatolia, Gordion (Turkey)	Voigt and Henrickson (2005)
Summers, G. D. (2008)	Early Phrygian Destruction	800 BC	Central Anatolia, Gordion (Turkey)	Voigt and Henrickson (2005)
Summers, G. D. (2008)	Middle Phrygian	ca. 800-540 BC	Central Anatolia, Gordion (Turkey)	Voigt and Henrickson (2005)
Summers, G. D. (2008)	Late Phrygian	ca. 540-330 BC	Central Anatolia, Gordion (Turkey)	Voigt and Henrickson (2005)
DeVries, K., Darbyshire, G., Rose, C. B., and Voigt, M. (2011)	Early Iron Age	ca. 1100 BC-900 BC	Gordion, Anatolia, present day Turkey	Voigt, M., n.d., ca. 1988

Source	Period Name	Date Range	Country/Geographic Region	Citation
DeVries, K., Darbyshire, G., Rose, C. B., and Voigt, M. (2011)	Early Phrygian	900-800 BC	Gordion, Anatolia, present day Turkey	Voigt, M., n.d., ca. 1988
DeVries, K., Darbyshire, G., Rose, C. B., and Voigt, M. (2011)	Middle Phrygian	after 800 BC-540s BC	Gordion, Anatolia, present day Turkey	Voigt, M., n.d., ca. 1988
DeVries, K., Darbyshire, G., Rose, C. B., and Voigt, M. (2011)	Late Phrygian	540s-333 BC	Gordion, Anatolia, present day Turkey	Voigt, M., n.d., ca. 1988
James, P. (1990)	Dark Ages	1200-800 BC	Central Anatolia/Gordion (Turkey)	Akurgal (1955)
James, P. (1990)	Phrygian Iron Age	Late 9th-7th c. BC	Central Anatolia/Gordion (Turkey)	
Çevik, Ö. (2008)	Iron I	1250-1000 BC	Eastern Anatolia	
Summers, G. D. (2008)	Early Iron Age	Early 12th-9th c. BC	Northeastern Central Anatolia (Turkey)	
Summers, G. D. (2008)	Middle Iron Age	9th-mid 7th c. BC	Northeastern Central Anatolia (Turkey)	
Summers, G. D. (2008)	Late Iron Age	Mid 7th-ca. 547 BC	Northeastern Central Anatolia (Turkey)	
Aharoni, Y. (1982)	Israelite (aka Iron Age) Period IA	1200-1150 BC	Israel	General select bibliography at end of book

Source	Period Name	Date Range	Country/Geographic Region	Citation
Aharoni, Y. (1982)	Israelite Period IB	1150-1000 BC	Israel	General select bibliography at end of book
Aharoni, Y. (1982)	Israelite Period IIA	1000-925 BC	Israel	General select bibliography at end of book
Aharoni, Y. (1982)	Israelite Period IIB	925-800 BC	Israel	General select bibliography at end of book
Aharoni, Y. (1982)	Israelite Period IIC	732-587 or 586	Israel	General select bibliography at end of book
Grabbe, L. (2007)	Iron IA	1200-1150 BC	Israel	Various sources cited
Grabbe, L. (2007)	Iron IB	1150-1000 BC	Israel	Various sources cited
Grabbe, L. (2007)	Iron IIA	1000-900 BC	Israel	Various sources cited
Grabbe, L. (2007)	Iron IIA (Listed but not officially part of Grabbe's chronology)	980-830 BC	Israel	Mazar
Grabbe, L. (2007)	Iron IIB	900-720 BC	Israel	Various sources cited.
Grabbe, L. (2007)	Iron IIC	720-539 BC	Israel	Various sources cited
GeoDia Database	Iron Age II	1000-586 BC	Israel	Winks and Mattern-Parkes (2004)
GeoDia Database	Iron Age IIB	925-722 BC	Israel	Winks and Mattern-Parkes (2004)

Source	Period Name	Date Range	Country/Geographic Region	Citation
Bruins, H. J., Nijboer, A. J., & Van der Plicht, J. (2011)	Iron IA	1200-1050 BC	Israel, Tel Dan	Biran (1994)
Bruins, H. J., Nijboer, A. J., & Van der Plicht, J. (2011)	Iron IB	1050-950 BC	Israel, Tel Dan	Biran (1994)
Bruins, H. J., Nijboer, A. J., & Van der Plicht, J. (2011)	Iron IIA	950-875 BC	Israel, Tel Dan	Biran (1994)
Bruins, H. J., Nijboer, A. J., & Van der Plicht, J. (2011)*	Iron IA	1000-900 BC	Israel, Tel Dan	Finkelstein (1999)
Bruins, H. J., Nijboer, A. J., & Van der Plicht, J. (2011)*	Iron IIA	900-850 BC	Israel, Tel Dan	Finkelstein (1999)
Finkelstein, I., & Piasetzky, E. (2010)	Early Iron I	1109-1047 BC	The Levant (Israel)	Original
Finkelstein, I., & Piasetzky, E. (2010)	Middle Iron I	1055-1028 BC	The Levant (Israel)	Original
Finkelstein, I., & Piasetzky, E. (2010)	Late Iron I	1037-913 BC	The Levant (Israel)	Original
Finkelstein, I., & Piasetzky, E. (2010)	Early Iron IIA	920-883 BC	The Levant (Israel)	Original
Finkelstein, I., & Piasetzky, E. (2010)	Late Iron IIA	886-760 BC	The Levant (Israel)	Original
Finkelstein, I., & Piasetzky, E. (2010)	Iron IIB-IIC	Ca. late 8th-early 6th c. BC	The Levant (Israel)	Authors note this date range out of scope for this study.

Source	Period Name	Date Range	Country/Geographic Region	Citation
GeoDia Database	Iron Age I	1200 BC-1000 BC	The Levant (Israelite)	Bertman (2003)
Mazar, A. (2005)	Iron I A	1200-1140/1130 BC	The Levant (Israel)	Based on Aharoni and Amiran (1958), with changes. For changes cites works in which Mazar is author or co-author
Mazar, A. (2005)	Iron IB	1150/40-ca. 980 BC	The Levant (Israel)	Based on Aharoni and Amiran (1958), with changes. For changes cites works in which Mazar is author or co-author
Mazar, A. (2005)	Iron IIa	ca. 980- ca. 840/830 BC	The Levant (Israel)	Based on Aharoni and Amiran (1958), with changes. For changes cites works in which Mazar is author or co-author
Mazar, A. (2005)	Iron IIb	ca. 840-830 BC-732/701 BC	The Levant (Israel)	Based on Aharoni and Amiran (1958), with changes. For changes cites works in which Mazar is author or co-author

Source	Period Name	Date Range	Country/Geographic Region	Citation
Mazar, A. (2005)	Iron IIIa	732/701-605/586 BC	The Levant (Israel)	Based on Aharoni and Amiran (1958), with changes. For changes cites works in which Mazar is author or co-author
Mazar, A. (2005)	Iron IIIc	605/586-520 BC	The Levant (Israel)	Based on Aharoni and Amiran (1958), with changes. For changes cites works in which Mazar is author or co-author
Younker, R. W. (2003)	Iron IA	1200-1150 BC	Palestine	Many sources cited
Younker, R. W. (2003)	Iron IB	1150-1000 BC	Palestine	Many sources cited
Younker, R. W. (2003)	Iron IB	1150-1050 BC	Palestine, Philistine	Many sources cited
Younker, R. W. (2003)	Iron IIA	10th c.-925 BC	Palestine	Many sources cited
Younker, R. W. (2003)	Iron IIB	900-721 BC	Palestine	Many sources cited
Younker, R. W. (2003)	Iron IIC	Late 8th-Mid 6th c. BC	Palestine	Many sources cited

Source	Period Name	Date Range	Country/Geographic Region	Citation
Dever, W. G. (2003)	Iron I	1200-1000 BC	Palestine and surrounding area	Many sources cited for chronology
Dever, W. G. (2003)	Iron II	1000-586 BC	Palestine and surrounding area	Many sources cited
Dever, W. G. (2003)	Iron III	586 BC-539 BC	Palestine and surrounding area	Many sources cited
GeoDia Database	Iron Age	1200 BC-586 BC	The Levant	Winks and Mattern-Parkes (2004)
GeoDia Database	Iron Age I	1200 BC-1000 BC	The Levant (Aramean)	Bertman (2003)
GeoDia Database	Iron Age II	1000-586 BC	The Levant (Assyrian)	Bertman (2003)
GeoDia Database	Iron Age IIC	722-586 BC	The Levant (Neo-Assyrian)	Winks and Mattern-Parkes (2004)
GeoDia Database	Iron Age III	586-539 BC	The Levant (Neo-Babylonian)	Winks and Mattern-Parkes (2004)
GeoDia Database	Iron Age II	1000-586 BC	The Levant (Phoenicia)	Winks and Mattern-Parkes (2004)
GeoDia Database	Iron Age I	1200 BC-1000 BC	The Levant (Phoenician)	Bertman (2003)
GeoDia Database	Iron Age II	1000-586 BC	The Levant (Syro-Palestinian)	Winks and Mattern-Parkes (2004)
Hodos, T. (2006)	Iron Age	1200 BC-600 BC	Northern Syria	For end date, Lehmann (1998)
Hodos, T. (2006)	Iron Age I	1100-900 BC	Northern Syria	
Hodos, T. (2006)	Iron Age II	900-610 BC	Northern Syria	

Source	Period Name	Date Range	Country/Geographic Region	Citation
* While Bruins *et al.* Include Finkelstein's chronology in a table, they do not support it.				

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Appendix B: Period Assertions for the Iron Age in England, France, and Germany (UKE)

Source	Period Name	Date Range	Country/Geographic Region	Citation
Snyder, C. A. (2003)	Hallstatt A1	1200-1100 BC	Europe	Gives bibliography for chapter, but difficult to pin sources to dates.
Snyder, C. A. (2003)	Hallstatt A2	1100-1000 BC	Europe	" "
Snyder, C. A. (2003)	Hallstatt B1	1000-900 BC	Europe	" "
Snyder, C. A. (2003)	Hallstatt B2	900-800 BC	Europe	" "
Snyder, C. A. (2003)	Hallstatt B3	800-700 BC	Europe	" "
Snyder, C. A. (2003)	Hallstatt C	700-600 BC	Europe	" "
Snyder, C. A. (2003)	Hallstatt D	ca. 600-500 BC	Europe	" "
Snyder, C. A. (2003)	La Tène 1a	ca. 500-400 BC	Europe	" "
Snyder, C. A. (2003)	La Tène 1b	ca. 400-300 BC	Europe	" "
Snyder, C. A. (2003)	La Tène 1c	ca. 300-200 BC	Europe	" "
Snyder, C. A. (2003)	La Tène II	ca. 200-100 BC	Europe	" "
Snyder, C. A. (2003)	La Tène III	ca. 100-0 BC	Europe	" "

Source	Period Name	Date Range	Country/Geographic Region	Citation
Snyder, C. A. (2003)	Earliest Iron Age	800-550 BC	Europe	" "
Snyder, C. A. (2003)	Early Iron Age	550-400 BC	Europe	" "
Snyder, C. A. (2003)	Middle Iron Age	400-100 BC	Europe	" "
Snyder, C. A. (2003)	Late Pre-Roman Iron Age	400-100 BC	Europe	" "
Portable Antiquities Scheme	Iron Age	800 BC-42 AD	England and Wales	Cites over 2,500 sources for its entire scheme
Hill, J. D. (1995)	Early Iron Age	ca. 700 BC-ca. 450 BC	Britain and Ireland	Collis (1984); Darvil (1987); Haselgrove (1993); Stead (1985)
Hill, J. D. (1995)	Middle Iron Age	ca. 450-ca. 100 BC	Britain and Ireland	Collis (1984); Darvil (1987); Haselgrove (1993); Stead (1985)
Hill, J. D. (1995)	Late Iron Age	ca. 100 BC-ca. 50 AD	Britain and Ireland	Collis (1984); Darvil (1987); Haselgrove (1993); Stead (1985)
Hill, J. D. (1995)	Hallstatt B	ca. 900-ca. 700 BC	Continental Europe	Collis (1984)
Hill, J. D. (1995)	Hallstatt C	ca. 700-600 BC	Continental Europe	Collis (1984)
Hill, J. D. (1995)	Hallstatt D	ca. 600-450 BC	Continental Europe	Collis (1984)
Hill, J. D. (1995)	La Tène A	ca. 450-350 BC	Continental Europe	Collis (1984)
Hill, J. D. (1995)	La Tène B	ca. 350-200 BC	Continental Europe	Collis (1984)
Hill, J. D. (1995)	La Tène C	ca. 200-100 BC	Continental Europe	Collis (1984)
Hill, J. D. (1995)	La Tène D	ca. 100 BC-0 AD	Continental Europe	Collis (1984)

Source	Period Name	Date Range	Country/Geographic Region	Citation
Heilbrunn Timeline of Art History (2000)	Iron Age	750 BC-50 BC	Western and Central Europe (Including U.K.)	
Collis, J. (1984)	Early Iron Age	650-400 BC	Southern England	
Collis, J. (1984)	Middle Iron Age	400-ca 125 AD	Southern England	
Collis, J. (1984)	Late Iron Age	125-ca. 0	Southern England	
Collis, J. (1984)	Gallo Belgic	ca. 0-50 AD	Southern England	
Collis, J. (1984)	Hallstatt I	700-600 BC	Central France	
Collis, J. (1984)	Hallstatt II	600-500 BC	Central France	
Collis, J. (1984)	La Tène I	ca. 525-225 BC	Central France	
Collis, J. (1984)	La Tène II	ca. 225-100 BC	Central France	
Collis, J. (1984)	La Tène III	100-50 BC	Central France	
Collis, J. (1984)	Hallstatt A	1200-1000 BC	Southern Germany	
Collis, J. (1984)	Hallstatt B	1000-700 BC	Southern Germany	
Collis, J. (1984)	Hallstatt C	700-600 BC	Southern Germany	Possibly Kossack (1959)
Collis, J. (1984)	Hallstatt D	600-ca. 475 BC	Southern Germany	Possibly Kossack (1959)
Collis, J. (1984)	La Tène A	ca. 475-400 BC	Southern Germany	Possibly Hildebrand (1874); Tischler (1885); Reinecke (1965); Hodson (1968); Collis (1975)
Collis, J. (1984)	La Tène B	ca. 400-225 BC	Southern Germany	Possibly Hildebrand (1874); Tischler (1885); Reinecke (1965); Hodson (1968); Collis (1975)
Collis, J. (1984)	La Tène C	ca. 225-125 BC	Southern Germany	Possibly Hildebrand (1874); Tischler (1885); Reinecke (1965); Hodson (1968); Collis (1975)

Source	Period Name	Date Range	Country/Geographic Region	Citation
Collis, J. (1984)	La Tène D	ca. 125-ca. 25 BC	Southern Germany	Possibly Hildebrand (1874); Tischler (1885); Reinecke (1965); Hodson (1968); Collis (1975)
Cunliffe, B. (2005)	Earliest Iron Age	800-ca. 600 BC	Britain	
Cunliffe, B. (2005)	Early Iron Age	ca. 600-400 or 250 BC	Britain	
Cunliffe, B. (2005)	Middle Iron Age	ca. 400 or 250 BC-100 BC	Britain	
Cunliffe, B. (2005)	Late Iron Age	100 BC-0	Britain	
Cunliffe, B. (2005)	Latest Iron Age	0-50 or 75 AD	Britain	
Cunliffe, B. (2005)	Hallstatt A1	1300-1200 BC	Europe	
Cunliffe, B. (2005)	Hallstatt A2	1200-1000 BC	Europe	
Cunliffe, B. (2005)	Hallstatt B1	1000-900 BC	Europe	
Cunliffe, B. (2005)	Hallstatt B2/3	900-800 BC	Europe	
Cunliffe, B. (2005)	Hallstatt C	800-600 BC	Europe	
Cunliffe, B. (2005)	Hallstatt D	600-ca. 475 BC	Europe	
Cunliffe, B. (2005)	La Tène I	ca. 475-250 BC	Europe	
Cunliffe, B. (2005)	La Tène II	ca. 250-150 BC	Europe	
Cunliffe, B. (2005)	La Tène III	150-50 BC	Europe	
ARENA Search Portal. (2004). Archaeological Records of Europe-Networked Access	Iron Age	800-43 AD	U.K.	

Source	Period Name	Date Range	Country/Geographic Region	Citation
British Museum "Explore World Cultures-Iron Age" and "Roman Britain"	Iron Age	800-43 AD	England and Wales	
GeoDia Database	Hallstatt D 2-3	700-450 BC	European	C.M. Witt
GeoDia Database	Iron Age A	800-300 BC	British	English Heritage Periods List
GeoDia Database	Iron Age B	300-100 BC	British	PAS Dating Conventions
GeoDia Database	Iron Age C	100 BC-43 AD	British	PAS Dating Conventions
GeoDia Database	Iron Age	800 BC-43 AD	British	Salway, Scullard

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